# A Further Case Against the Automobile

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Further to a note in which the automobile was shown to be the direct physical cause of millions of adult moth deaths annually (*Ent. Rec.*, **89**: 330), I reproduce here the results of preliminary research into the pollution of lepidoptera by lead from motor cars.

Since 1923 lead has been added to petrol as an anti-knock agent to raise octane rating. The present level of augmentation results in approximately 10,000 tons of lead being combusted in U.K. petrol per annum (1974, D.o.E. Report). The lead is emitted in exhaust gases as inorganic compounds, polluting the surrounding area to a greater or lesser degree dependant on proximity to source. As a measure of this growing problem, a four fold increase in atmospheric lead occurred from 1730 to 1950 with a similar increase during the following decade (Walker, 1975).

In most stages, lepidoptera form a large and important section of diet for many of our varied fauna. Larvae ingest large quantities of botanical material including that which is polluted — the adults retaining quantities of such metallic contaminants. There is strong evidence for the biological concentration of lead in insect food chains as has been shown in America (Price, Ratche and Gentry, 1974), where levels 2½ times that of normal were recorded in insects sampled from areas with high lead emission — in this case interstate highways.

With these facts in mind I decided chemically to analyse several species of common adult lepidoptera for lead levels. The species chosen were those which were sufficiently abundant to assure accurate analysis and those which covered a wide spectrum of common foodplant types. To avoid any unnecessary mortalities the specimens used were those utilised for distribution research by Rothamsted Experimental Station for the years 1976 and 1977 — all specimens being taken from a single site in Brighton, Sussex. In an effort to confirm that the normal level of lead in these species was as expected, the Booth Museum of Natural History in Brighton kindly contribute specimens caught during the 1880's from the county of Sussex. Unfortunately the presence of minute traces of lead in the pins prevented any accurate determinations being made — due to an apparent leaching effect.

By coincidence, during July 1977 after the following results were almost completed, the regional press reported on a conservation group's lead level results obtained from two dust samples taken from nearby Worthing. Figures of 1,000 ppm. and 2,000 ppm. (parts per million) were quoted, indicating that considerable "fall-out" had occurred.

My own results were as follows: *Eurrhypara hortulata* L., 6 lead in ppm.; *Hepialus sylvina* L., 7 lead in ppm.. *Opisthograptis luteolata* L., 11 lead in ppm.; *Abraxas grossulariata* L., 8 lead in ppm.; *Malacosoma neustria* L., 7 lead in

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ppm.; *Crocallis elinguaria* L., 18 lead in ppm.; *Agrotis exclamationis* L., 8 lead in ppm.; *A. puta puta* Hb., 34 lead in ppm.; *Mythimna impura impura* Hübn., 6 lead in ppm.; *M. pallens* L., 9 lead in ppm.; *Mesapamea secalis* L., 12 lead in ppm.

The figures indicate a low level of contamination by lead pollution in the majority of species examined. However, two species (*C. elinguaria* and *A. puta puta*) yielded figures which are somewhat disturbing — equalling contamination levels found in plant eating insects sampled from alongside American state highways.

To put in perspective the direct danger to lepidopterous larvae through lead poisoning, experiments on silk worms (*Bombyx mori*) in Japan (Matsubara, Fujiyoshi, Kimura, Yukio, 1974) revealed the following responses: (a) 200 ppm. lead — inhibition of growth. (b) 1,000 ppm. lead — some deaths. (c) 3,000 ppm. lead — total lethality.

Captured, as the moths were, from the northern urban periphery of Brighton in Sussex, it is to be expected that a mixture of larval environments were experienced with a possible predilection towards relatively lead free circumstances — with higher lead levels to be found by selective larvae collecting.

In overall conclusion, it would appear that there is considerable leeway before the direct consequences of lead pollution are to be noticed in lepidopterous larvae, at least in Sussex — given the same interspecies susceptibility. Nevertheless, this does not diminish the apparent threat to similar or higher forms of wild life at more elevated stages in food chains, by biological concentration.

## References

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Matsubara, F. and Kimura, Y., 1974. Effect of Heavy Metals on *Bombyx mori. Bull. Faculty of Textile Science,* 7, part 2, 213, 234.

Price, P. W., Ratchie, B. J. and Gentry, D. A., 1974. Environmental Entomology, Lead in Terrestrial Arthropods. *Evidence for Biological Concentration,* 3, part 3, 370-372.

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Autumn Migrants at Bradwell-on-Sea, Essex, 1977. — The following species were noted here at m.v. traps — October: 14th, *Mythimna vitellina* Hb. (♀), *Agrotis ipsilon* Hufn. (29); 15th, *Peridroma saucia* Hb. (1), *A. ipsilon* (94); 16th, *P. saucia* (1), *A. ipsilon* (58); 17th, *A. ipsilon* (88); 18th, *P. saucia* Hb. (1), *A. ipsilon* (46), *Orthonama obstipata* F. (♀); 19th, *Palpita unionalis* Hb. (♂), *A. ipsilon* (18), *O. obstipata* (♂); 20th, *M. vitellina* (♂), *O. obstipata* (♂, ♀), *P. unionalis* (♂), *A. ipsilon* (13th); 21st, *P. unionalis* (♂, ♀), *A. ipsilon* (7); 22nd, *Udea ferrugalis* Hb. (♂), *Cyclophora puppillaria* Hb. (♂); 27th, *O. obstipata* (♀), *A. ipsilon* (4). November: 6th, *P. unionalis* (♂), *A. ipsilon* (1). — A. J. Dewick, Curry Farm, Bradwell-on-Sea, Essex.